# Validation of V5 Cloud Cleared Radiances using ECMWF

L. Larrabee Strow, Scott Hannon, Sergio DeSouza-Machado

Atmospheric Spectroscopy Laboratory (ASL)
Physics Department
and the
Joint Center for Earth Systems Technology

**University of Maryland Baltimore County (UMBC)**

April 16, 2008

# Overview

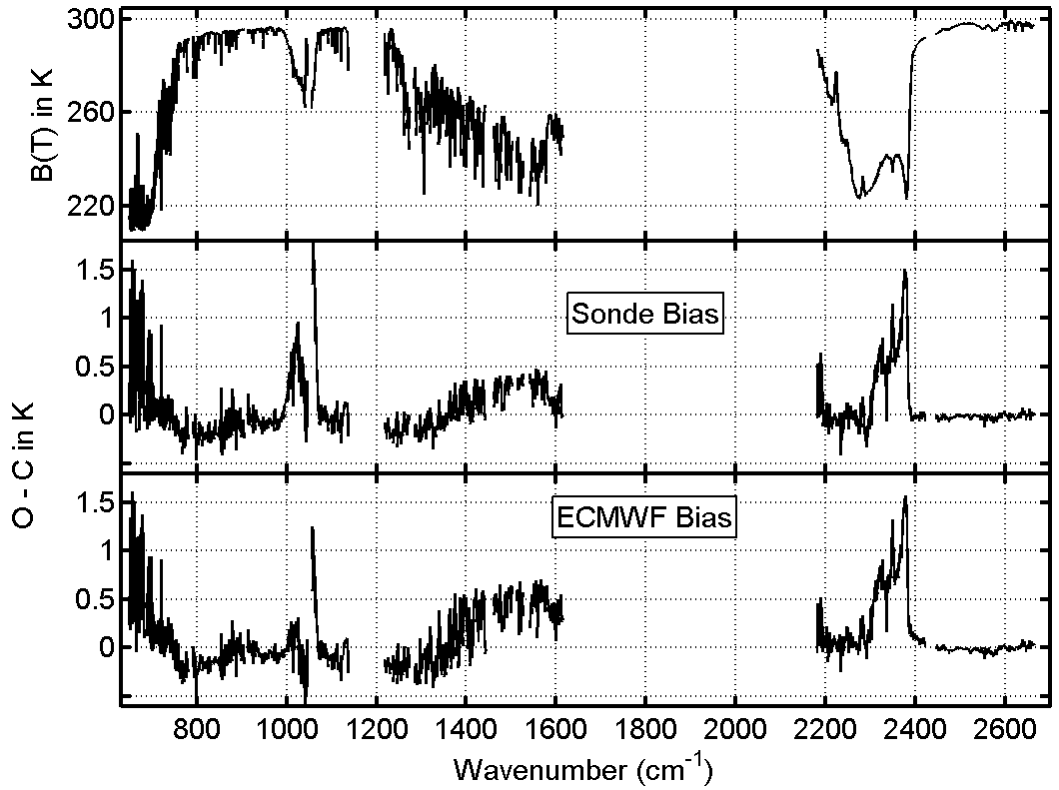


- Cloud-cleared radiances are used for retrievals, so should be validated
- Direct validation using radiosondes has not taken place, maybe a task for the future.
- Here we just compare the L2 cloud-cleared radiances to clear-sky radiances computed using ECMWF

# Background



- We have extensively used ECMWF for validating the AIRS RTA and for $CO_2$ retrievals.
- ECMWF statistically agrees very well with direct RS-90 sonde biases for clear scenes (see below - but here SST from fit)



# Procedure

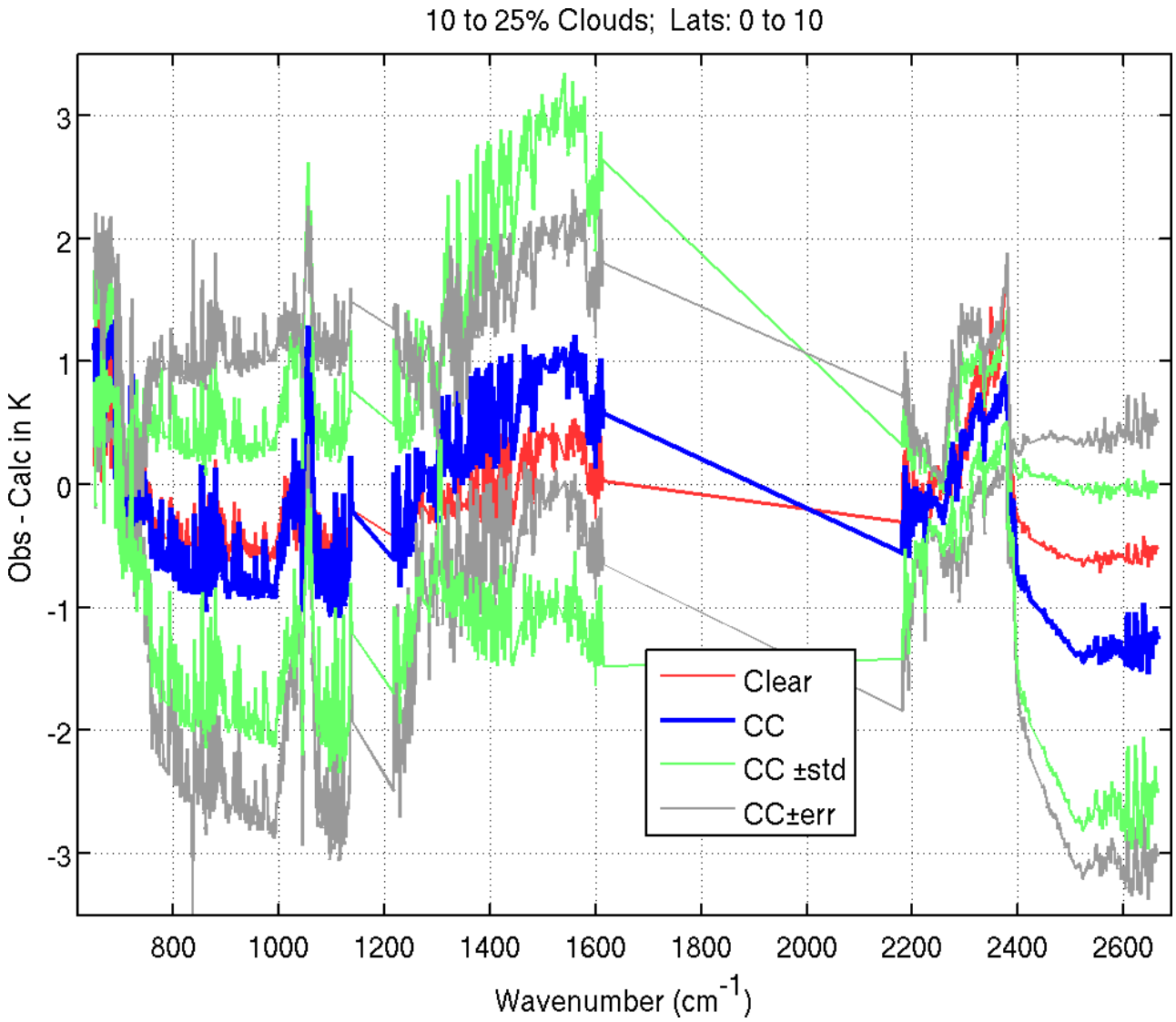
- L2 cloud-cleared radiances from May 1-7, 2004 matched with ECMWF model fields
- Used only L2 CC quality flag “Qual_CC” = best
- Subset to ocean, night scenes
- Used SARTA to compute clear radiances
- Roughly binned results (0-10,10-25,25-50,50-100%) using FOR cloud fraction = “TotCld_4_CCfinal’
- Create 10 degree latitude bins of biases, $\pm 70$ degrees
- Compare to UMBC’s “uniform_clear” clear-scene biases for May 2004 for reference
- Will also show L2 CC error estimates = “radiance_err”

ASL

# Example: 10-25% Cloud in FOR, 0°to +10°Lat.

Clear = “uniform_clear”, CC = Cloud-cleared, std = Bias Std, err = CC error in L2



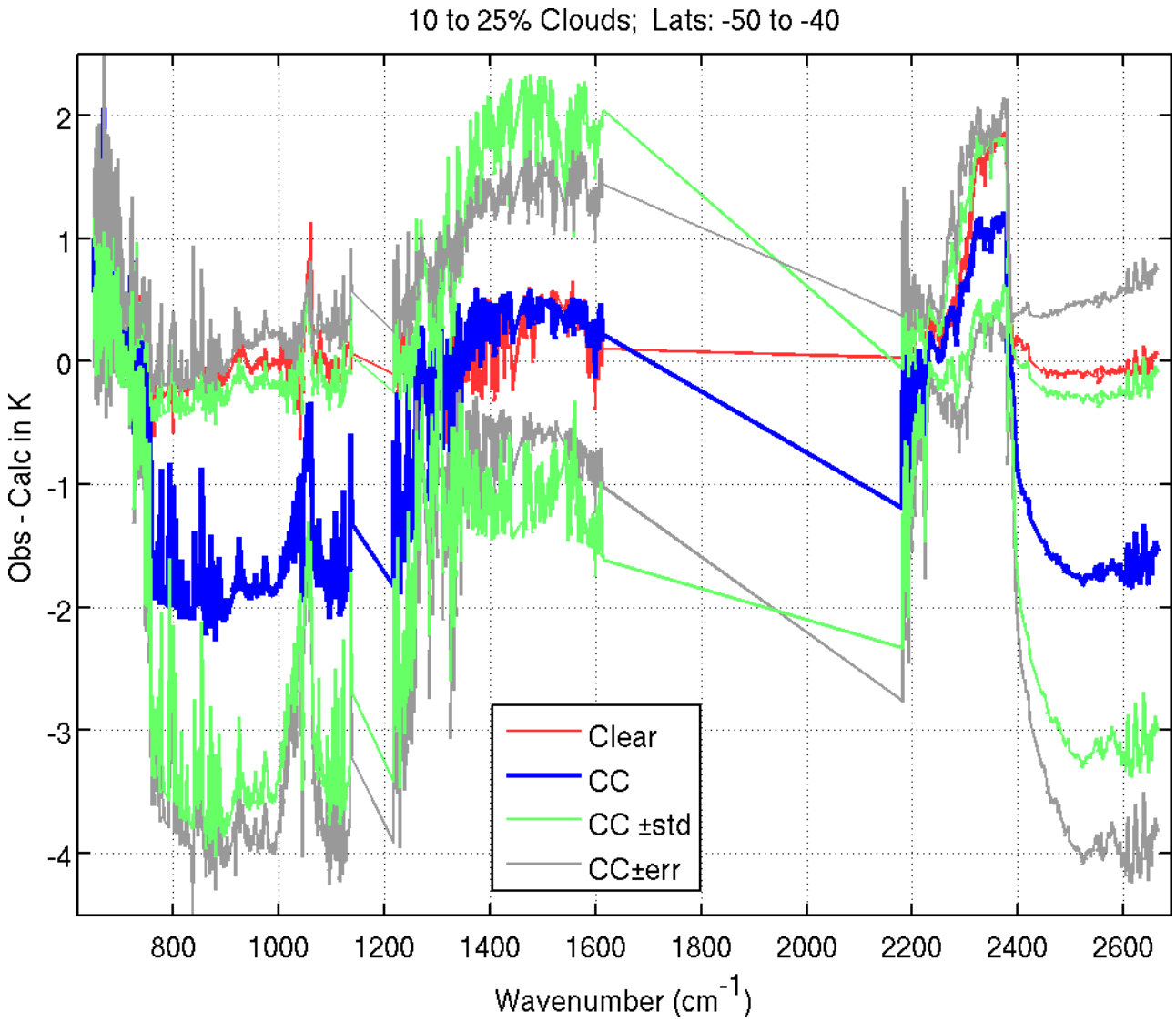


ASL

# Example: 10-25% Cloud in FOR, -40°to -50°Lat.

## Note large cold bias for CC in windows



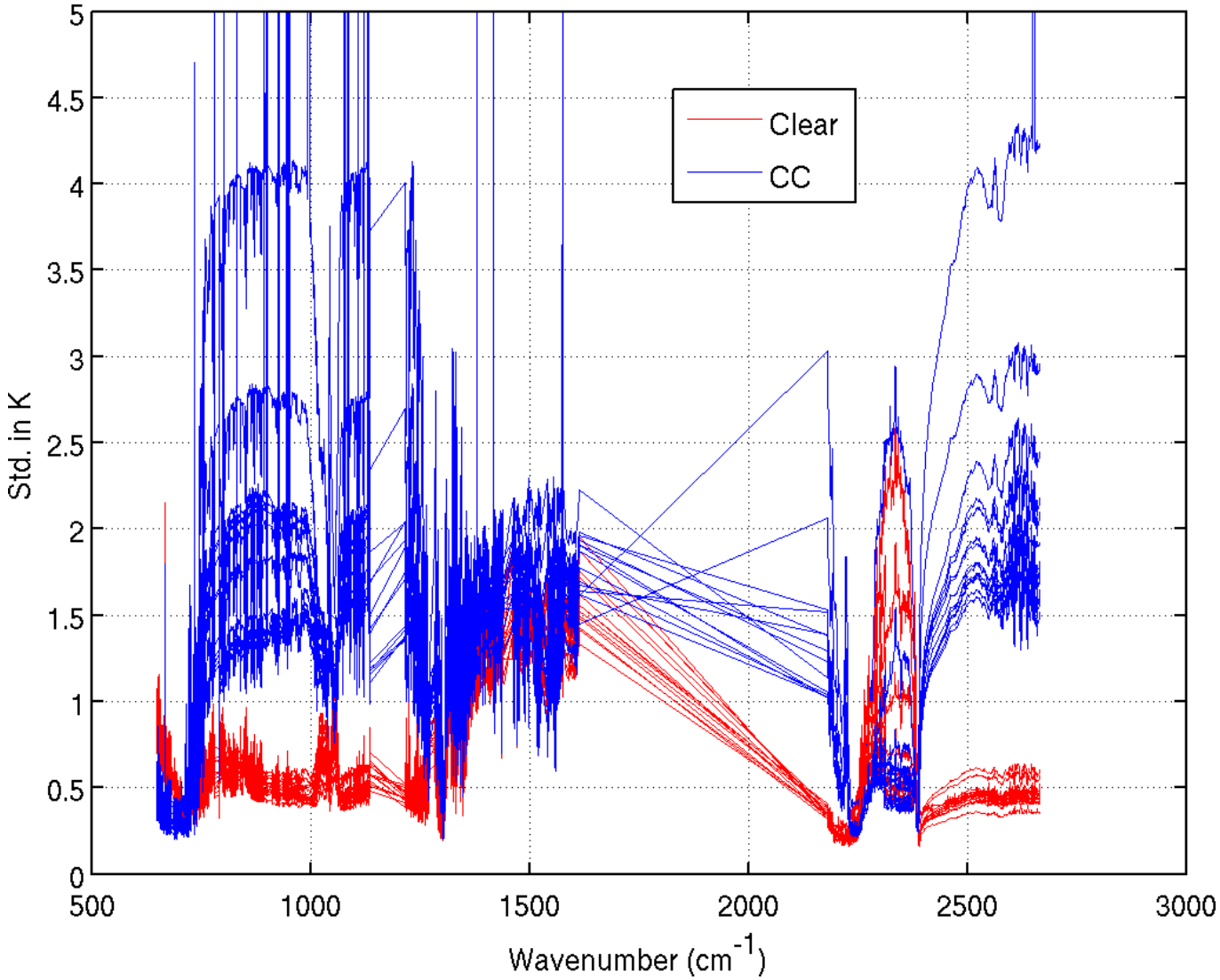


ASL

# Std. Dev. of "uniform_clear" vs L2 CC (all lats)

## Note CC std better in longwave as expected



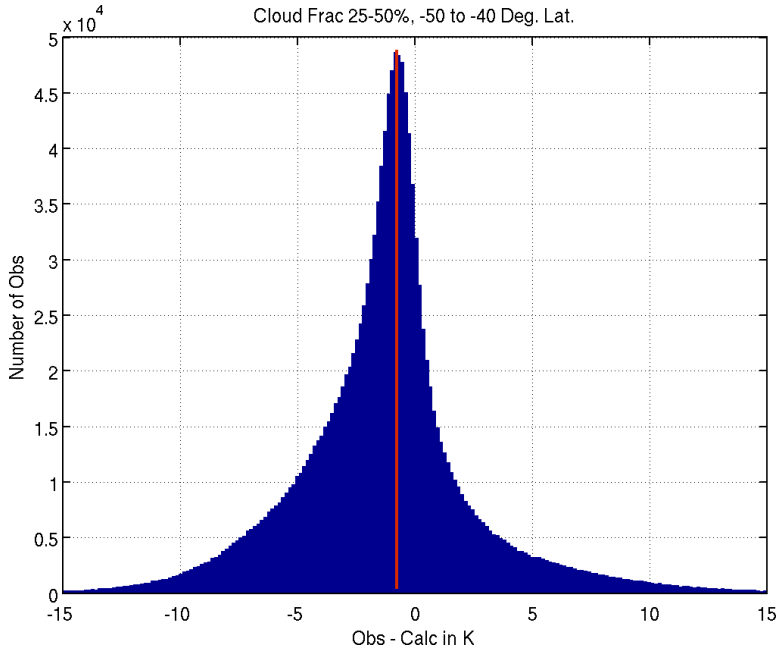


# Histograms of -50°to -40°Biases (961 $cm^{-1}$)

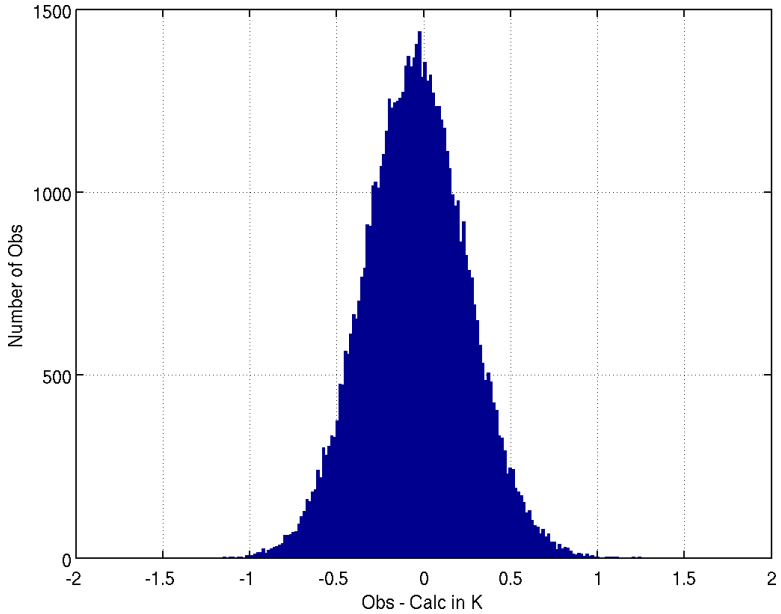
## Shows cloud leakage



### L2 CC Bias




### L1b "Uniform_clear"




Note different scales for Obs-Calc.

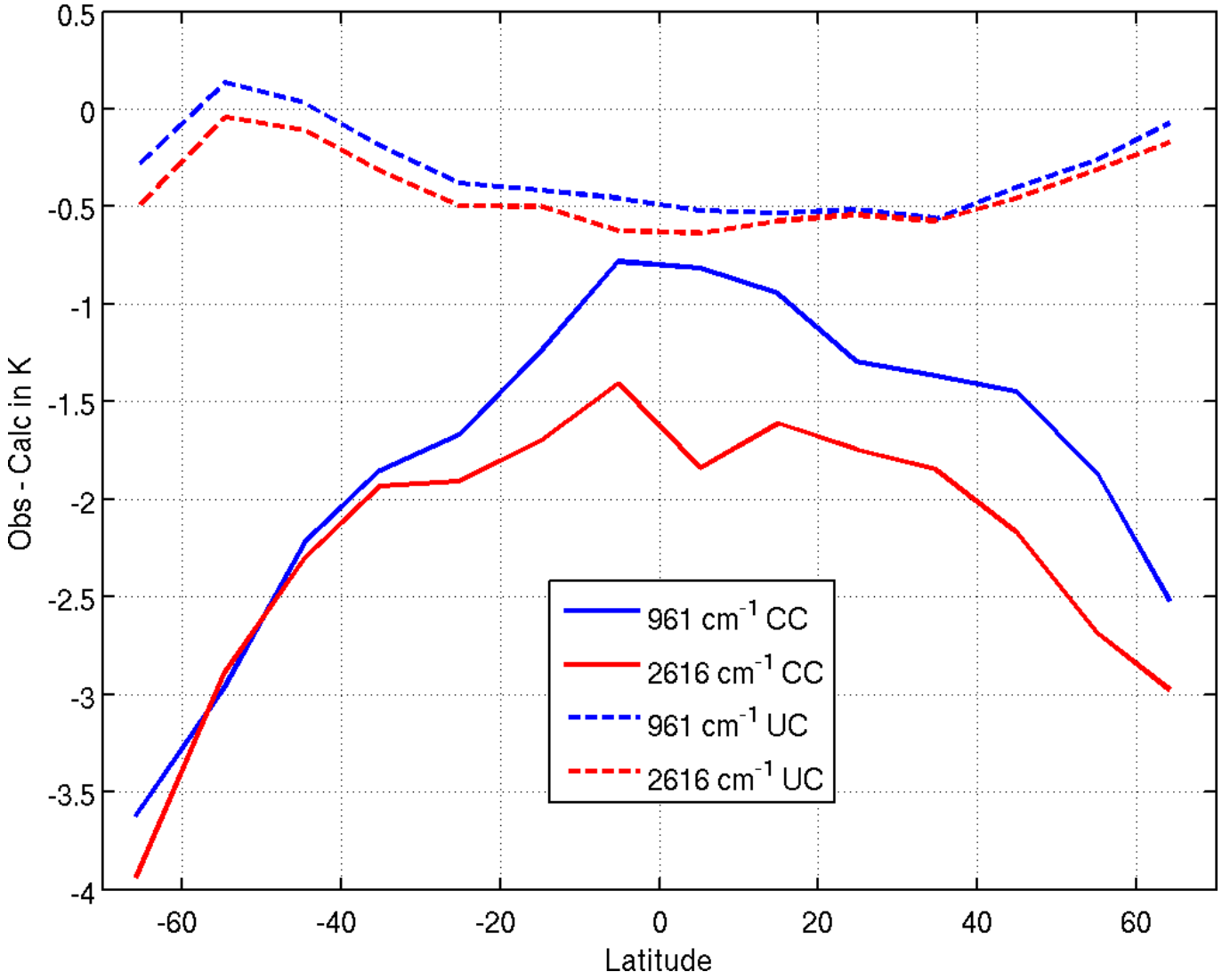
ASL

# Window Channel Bias vs Latitude (25-50% Clouds)

## CC = L2 CC BT Bias, UC = UMBC "uniform_clear" BT Bias

CC Rad. Val.

L. Strow

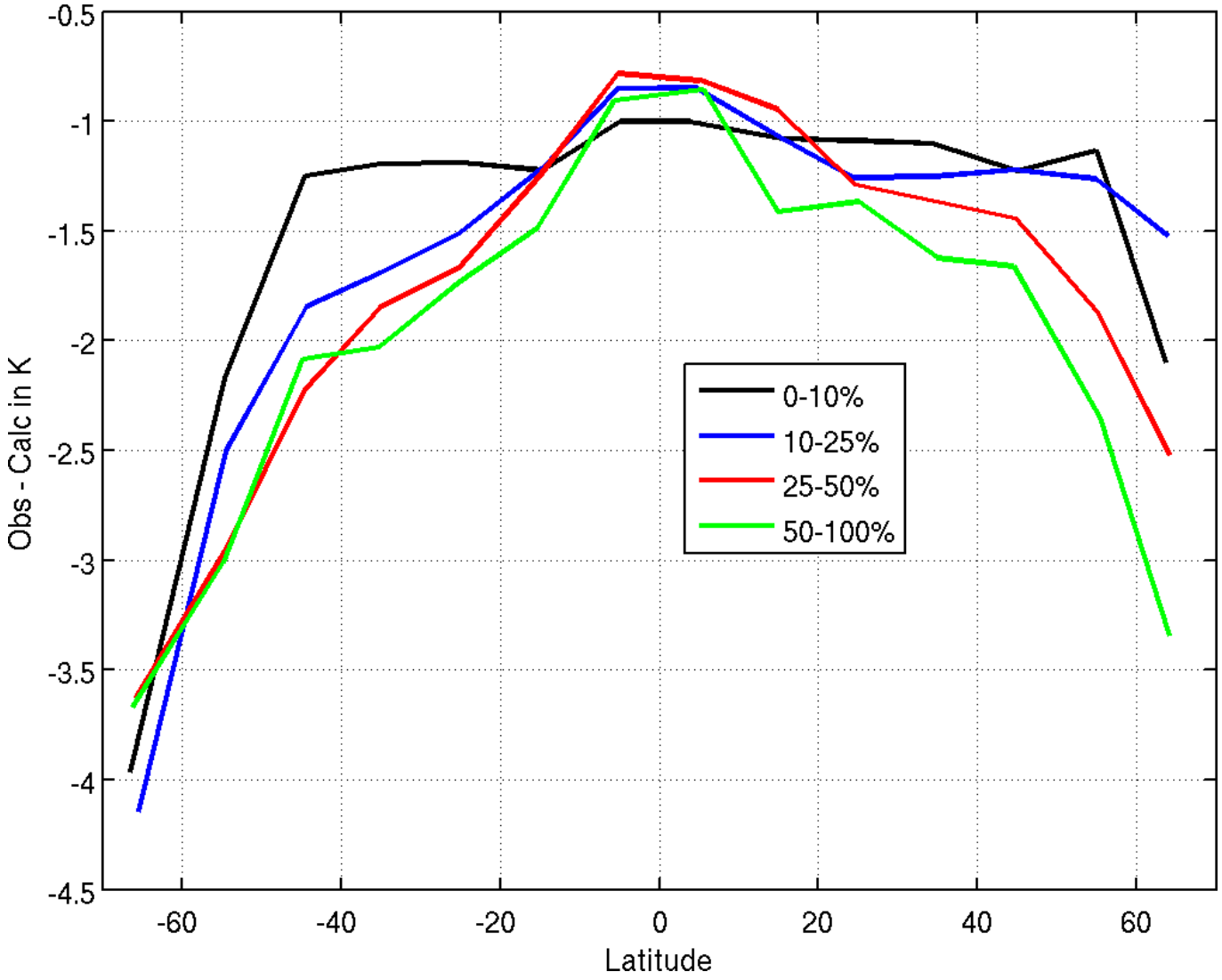


ASL

# Window Channel Bias vs Latitude vs Cloud Amount
# 961 $cm^{-1}$ Channel

CC Rad. Val.

L. Strow



# Observations: Window Regions
(More examples in later slides if time)

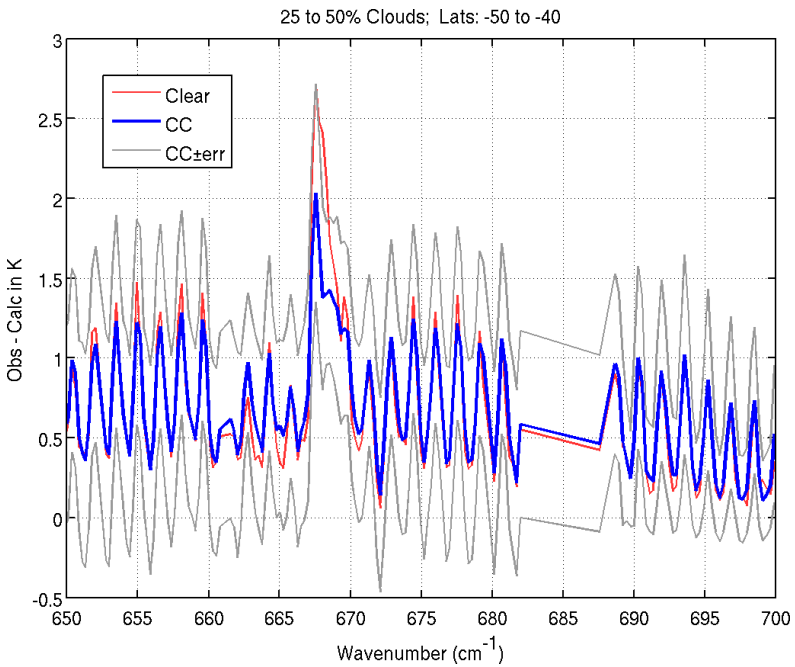


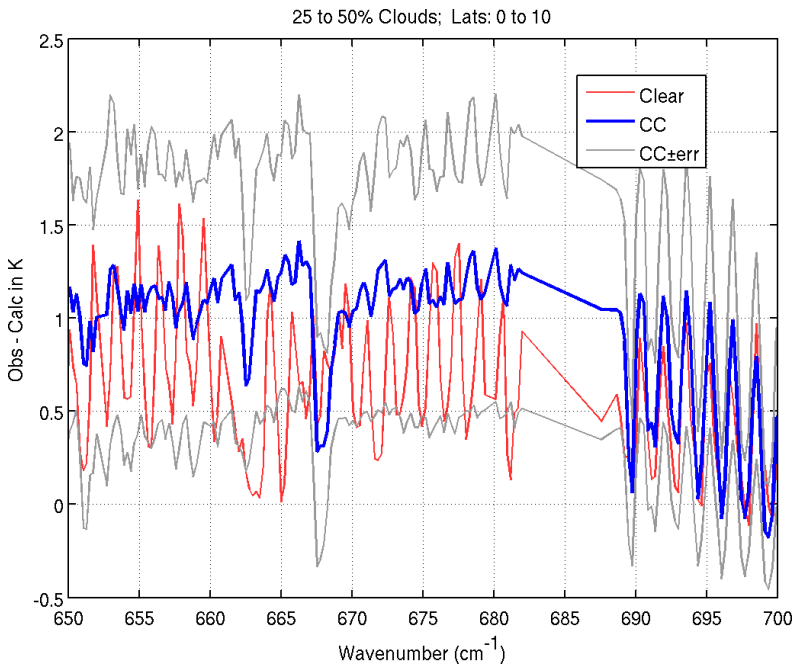
- L2 CC BTs appear to have a 0.5 to 3.5K cold bias, but stated errors reflect this.
- Bias is relatively independent of cloud coverage in FOR
- L2 CC radiance reported errors overestimate statistical error in tropics, and are just barely large enough in higher latitudes
- In high latitudes, (L2 CC radiance + Error Est) $\approx$ true "clear" bias (red curve).
- Should L2 retrieval include a low water cloud in the retrieval??
- Is this a sampling error, ECMWF SST incorrect under cloudy conditions - doubtful

# L2 CC Biases in 15 $\mu m$ Spectral Region



- Higher latitudes: L2 CC biases similar to UMBC "uniform_clear" biases
- Lower latitudes: L2 CC biases are spectrally flat. L2 CC biases seem to be too high in-between lines.
- Differences are small, ~0.5K

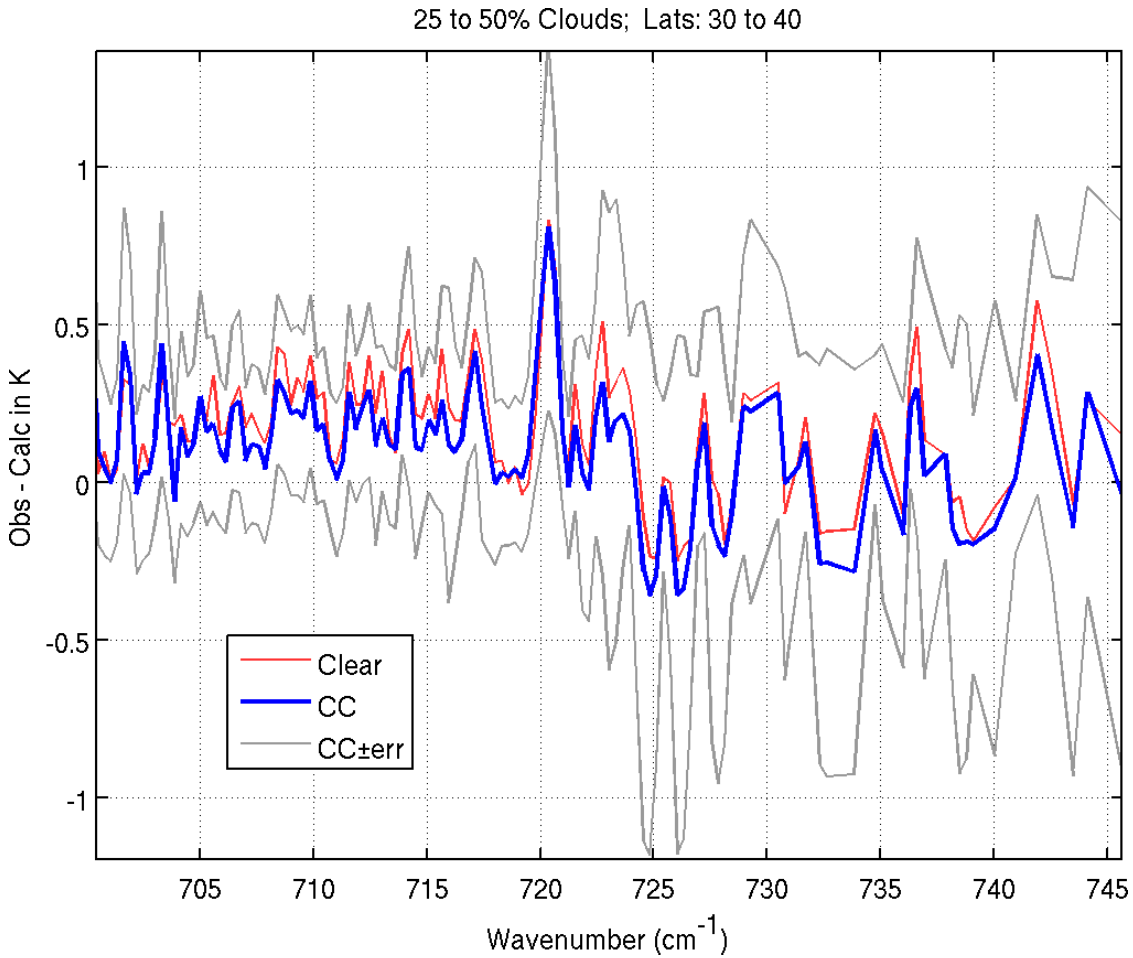


# Mid-Tropospheric Sounding Region



In the mid-tropospheric sounding region the L2 CC biases are very similar to UMBC “uniform_clear” radiances



# Conclusions

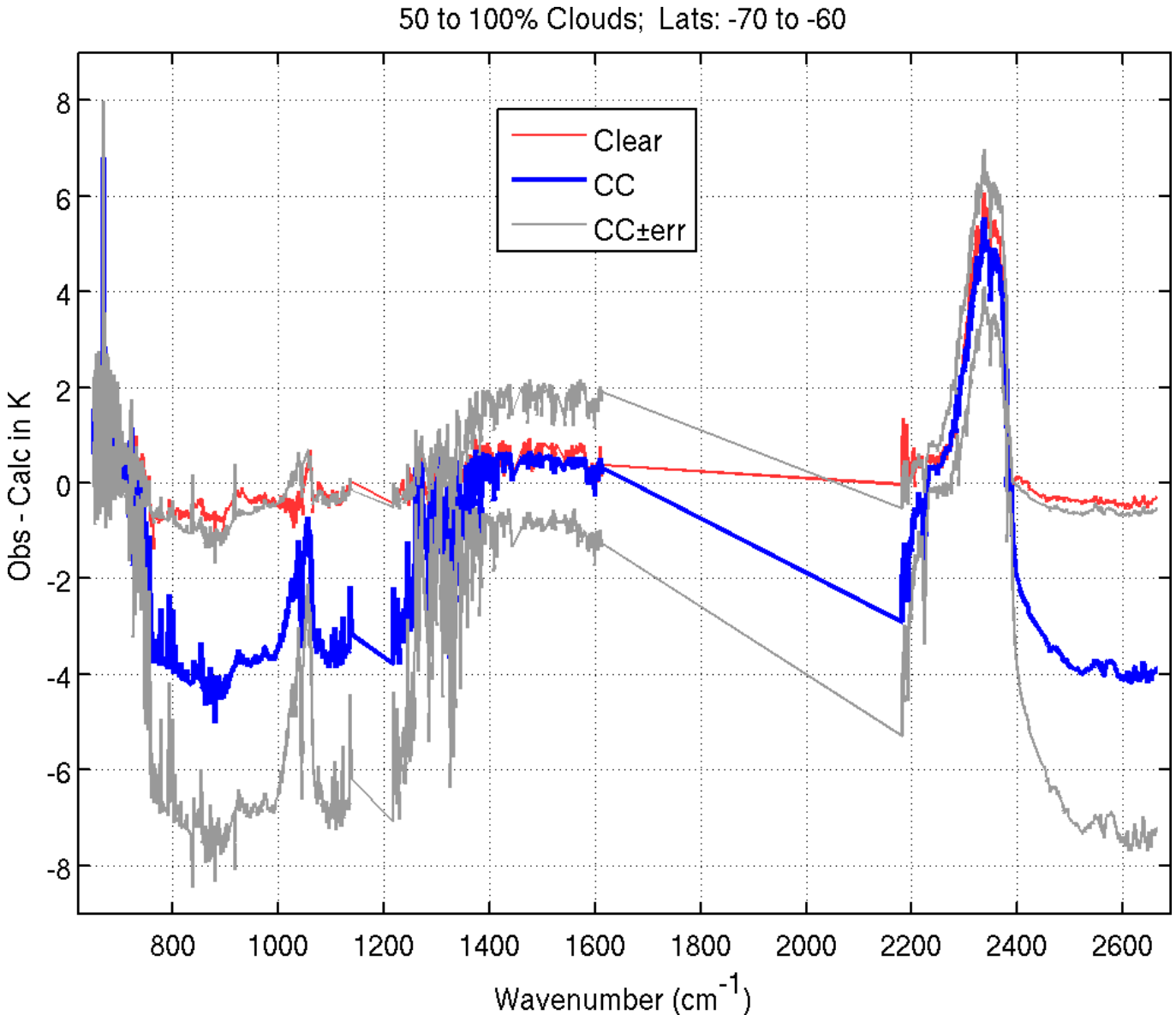
- L2 CC'd window radiances have significant cold biases, esp. at higher, winter latitudes
- L2 CC'd error estimates are conservative and cover estimated error
- Mid-tropospheric L2 CC'd radiances appear quite accurate, ~0.2K level
- Upper-tropospheric L2 CC'd radiances are accurate at high latitudes, seem to have ~0.5K systematic errors in the tropics

# Extra L2 CC Bias Slides to Follow

# L2 CC Bias vs “uniform_clear” Bias



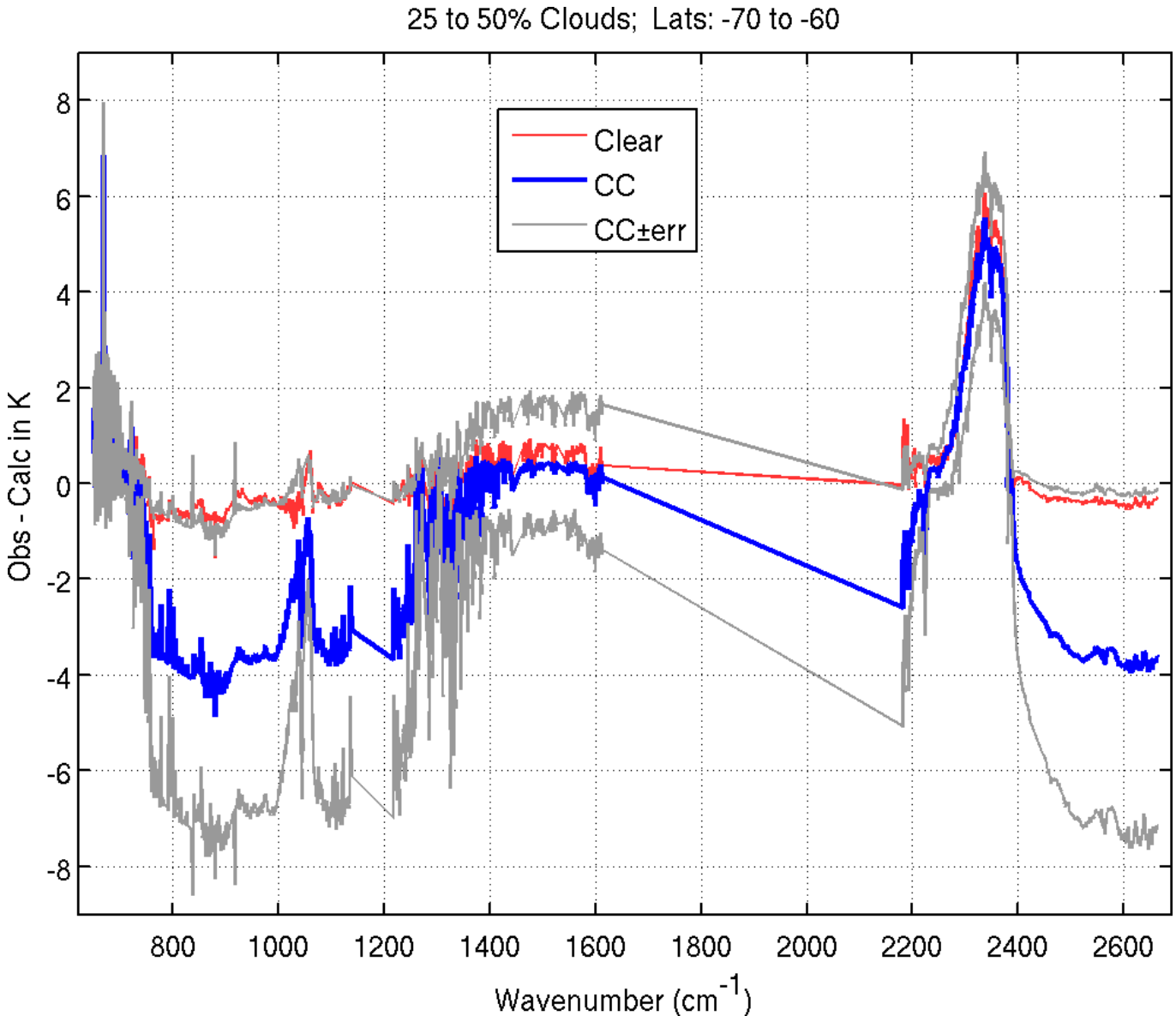
L. Strow



# L2 CC Bias vs “uniform_clear” Bias

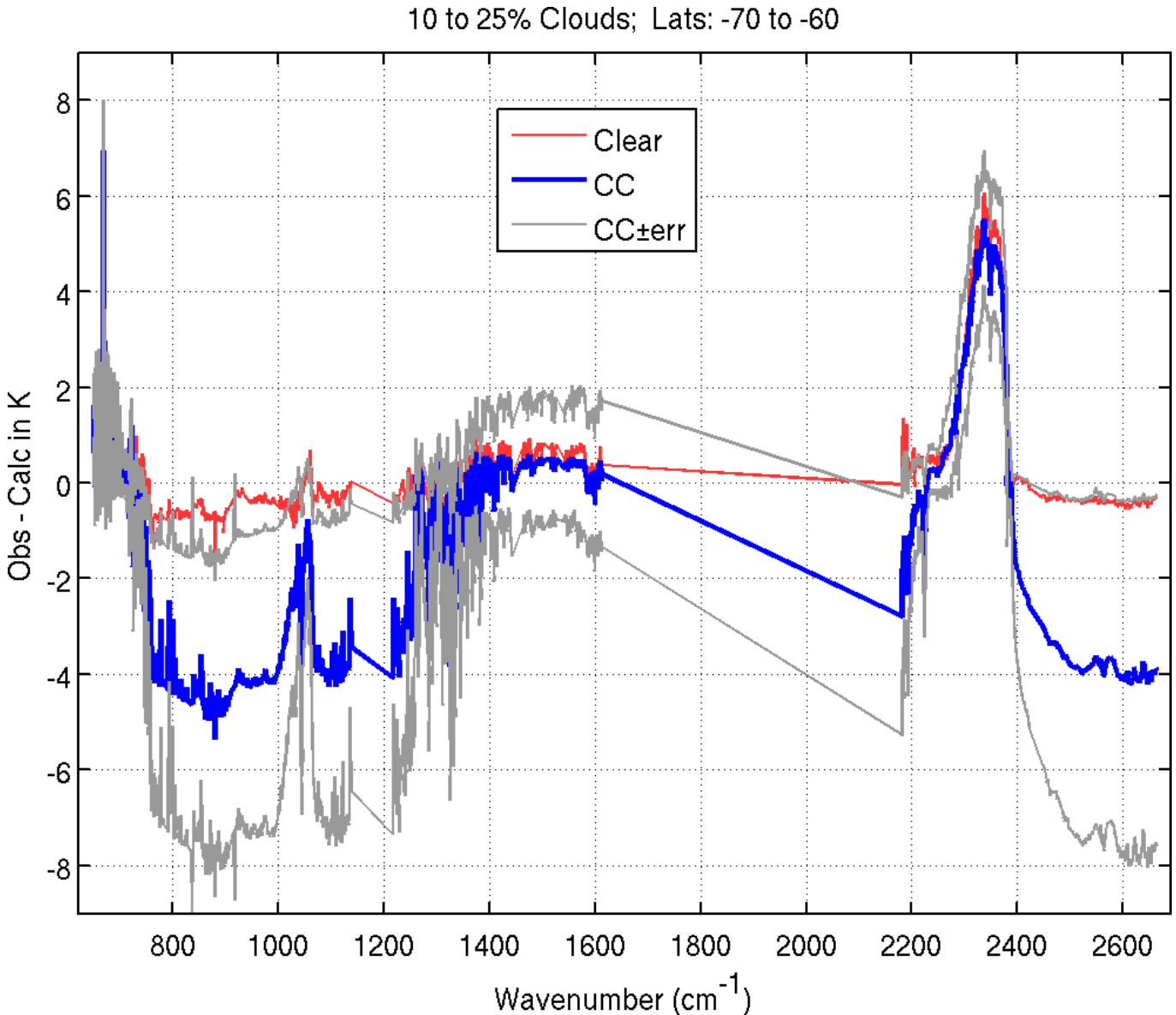


L. Strow



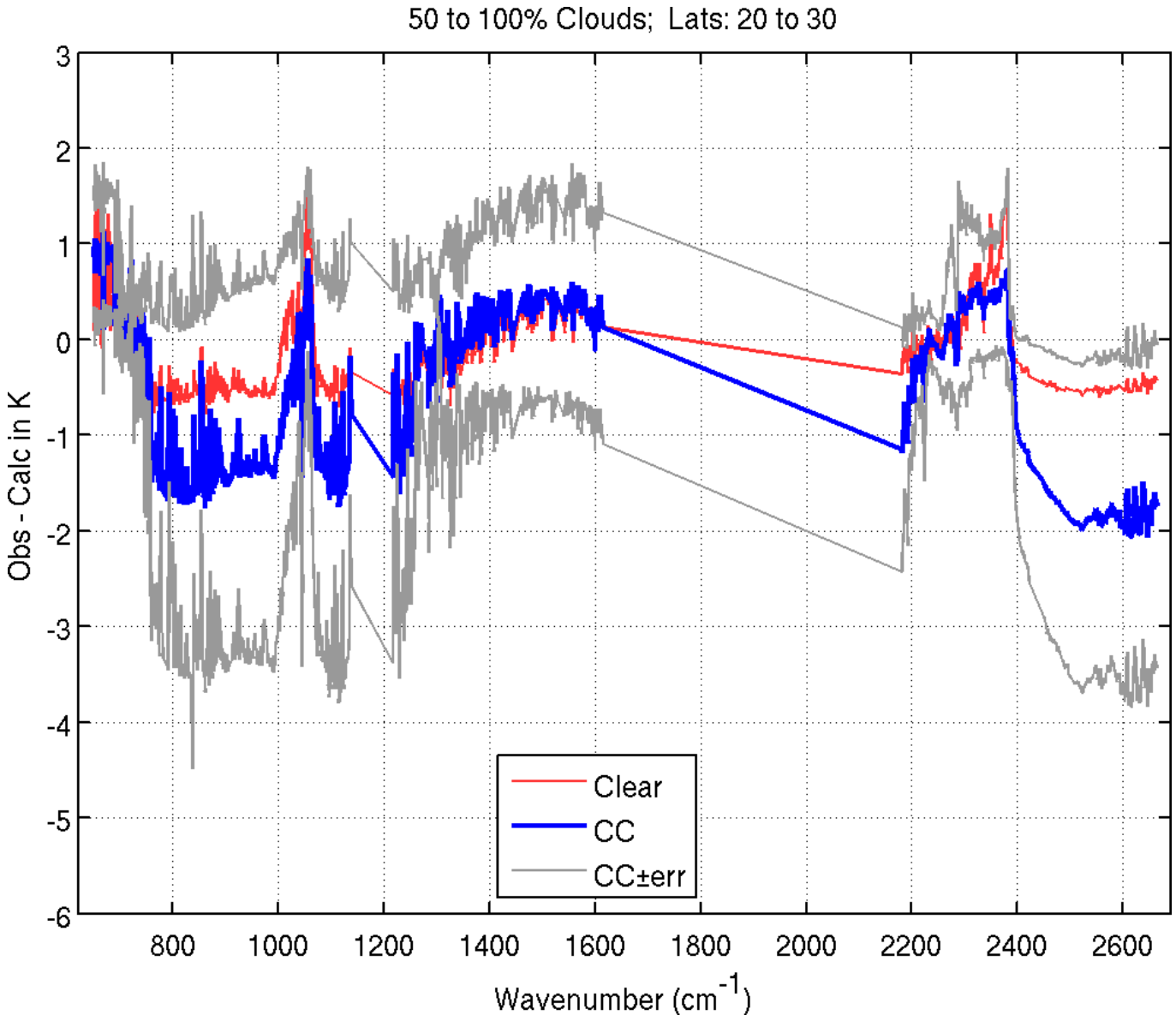
# L2 CC Bias vs “uniform_clear” Bias





# L2 CC Bias vs “uniform_clear” Bias

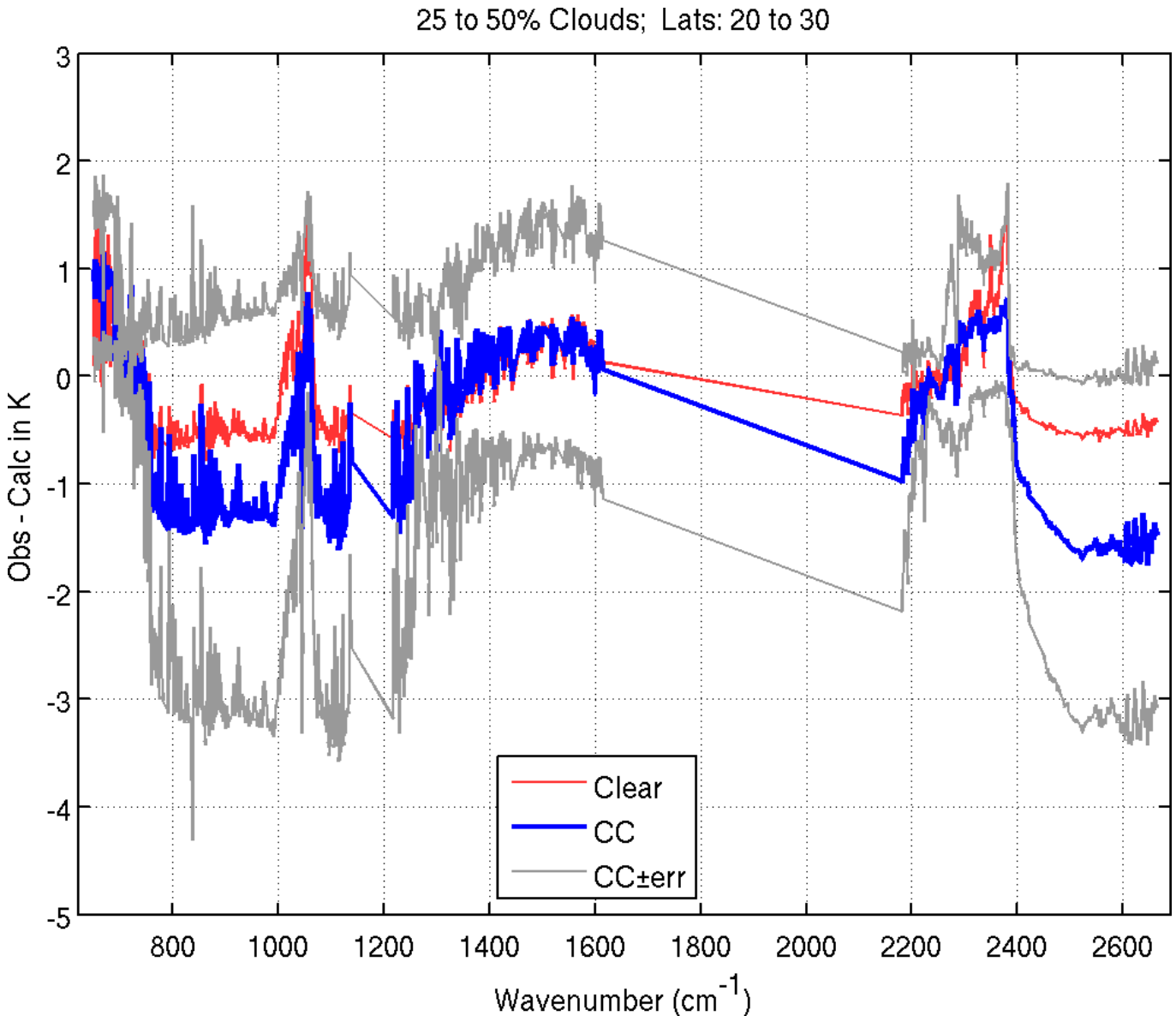




# L2 CC Bias vs “uniform_clear” Bias



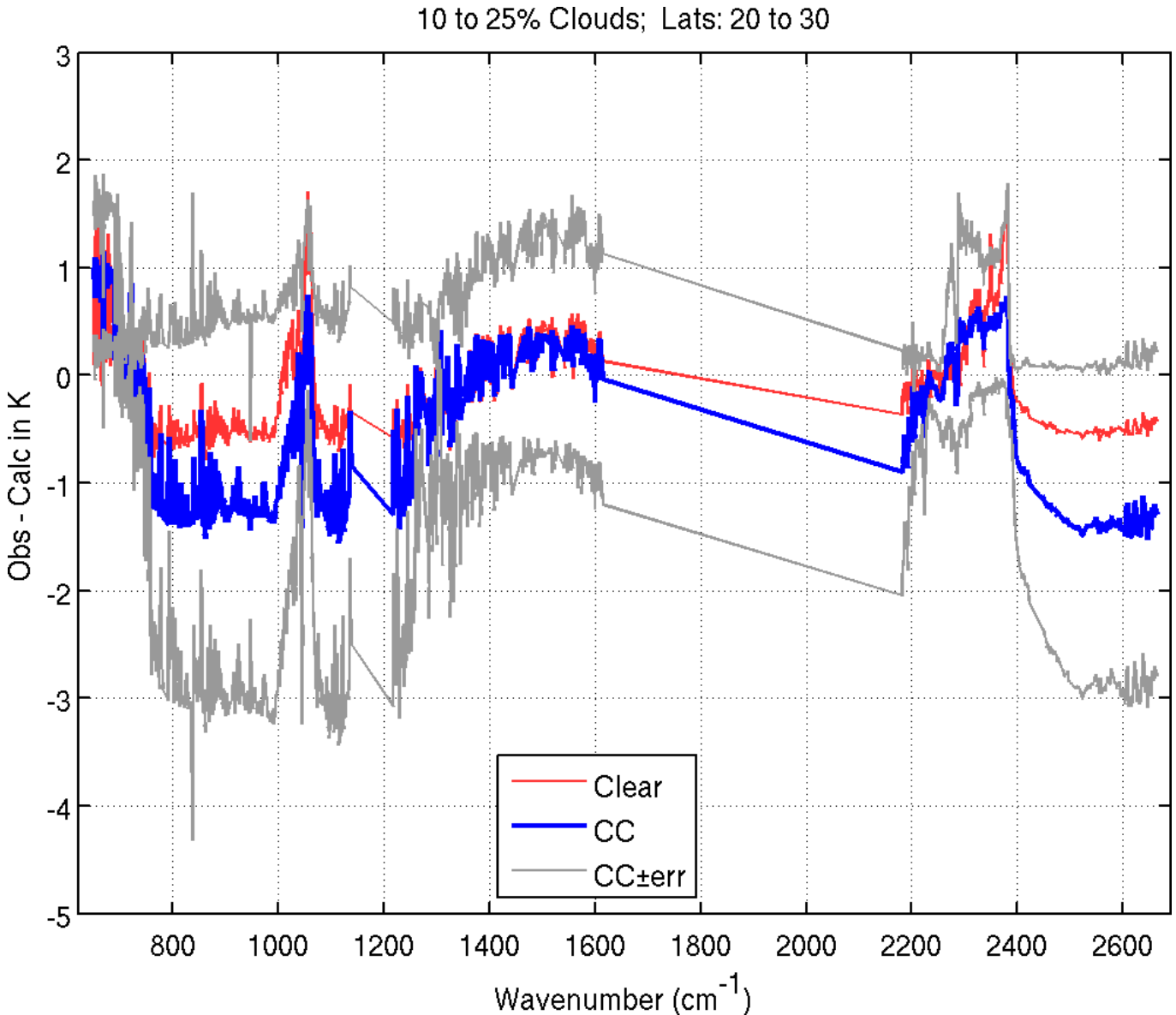
L. Strow



# L2 CC Bias vs “uniform_clear” Bias

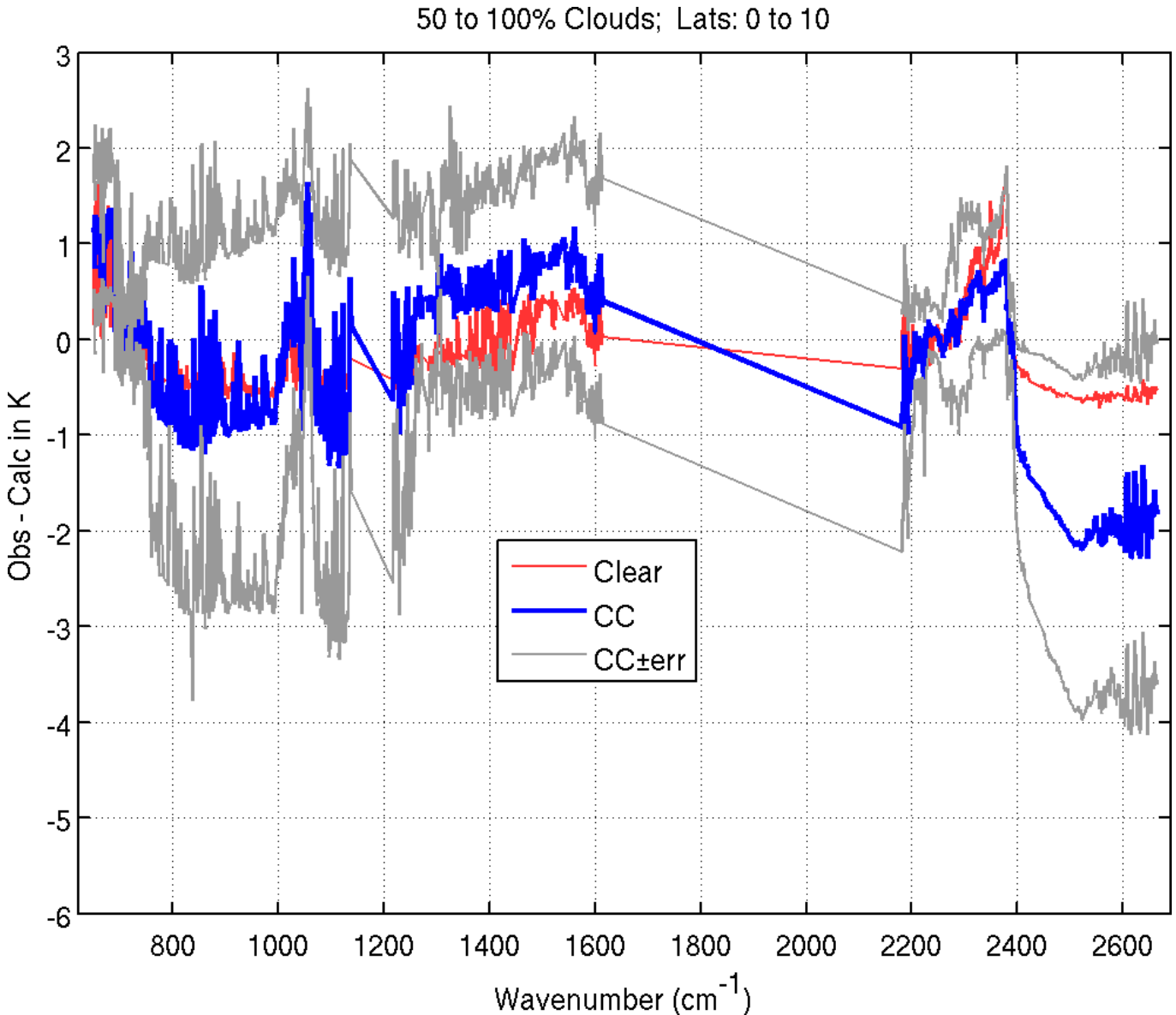


L. Strow



# L2 CC Bias vs “uniform_clear” Bias

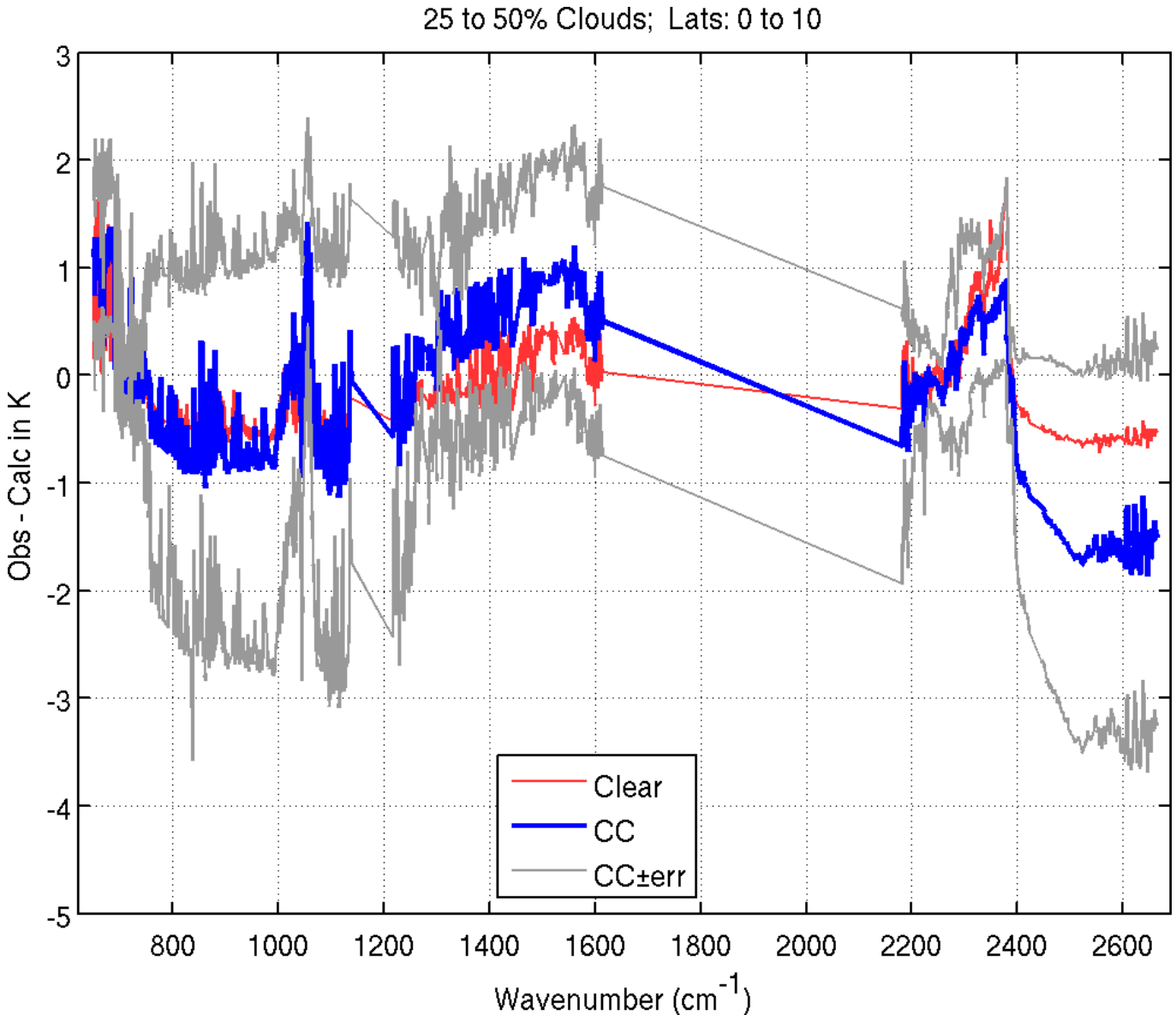




# L2 CC Bias vs “uniform_clear” Bias



L. Strow



# L2 CC Bias vs “uniform_clear” Bias



L. Strow